Weakly supervised learning

label noise and correction

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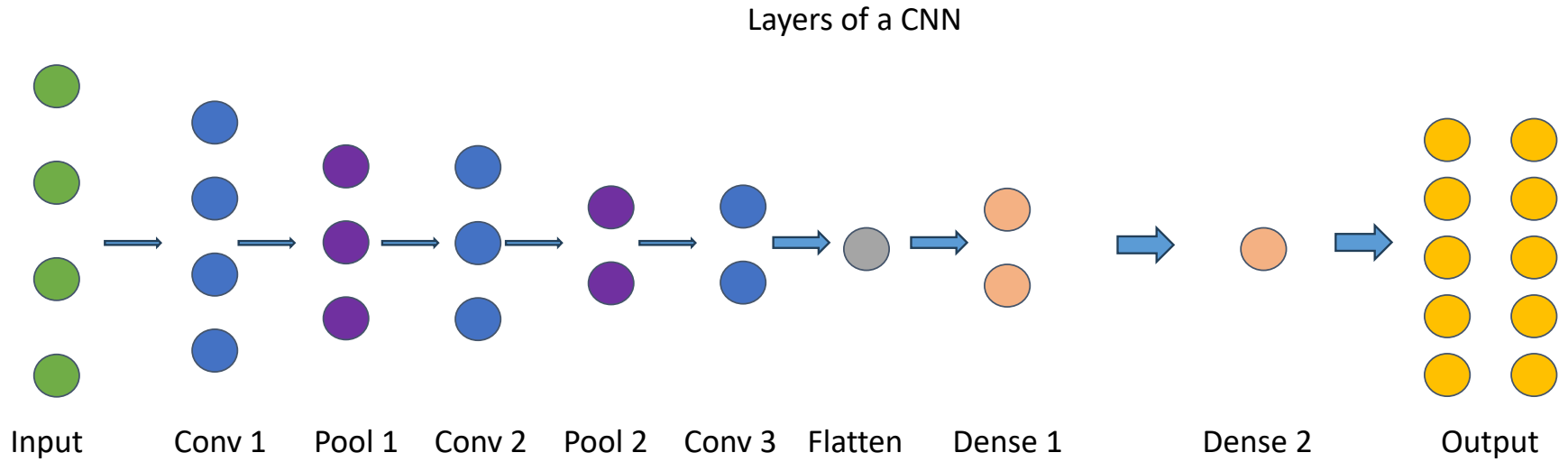
Model I: Convolutional Neural Network

Convolutional Neural Network (CNN) is a regularized unidirectional neural network that self selects features. It is inspired by the biological features of animals, specifically the visual vortex in that neurons only respond to stimuli in a given region. It includes the input layer, hidden layers, and the output layer.



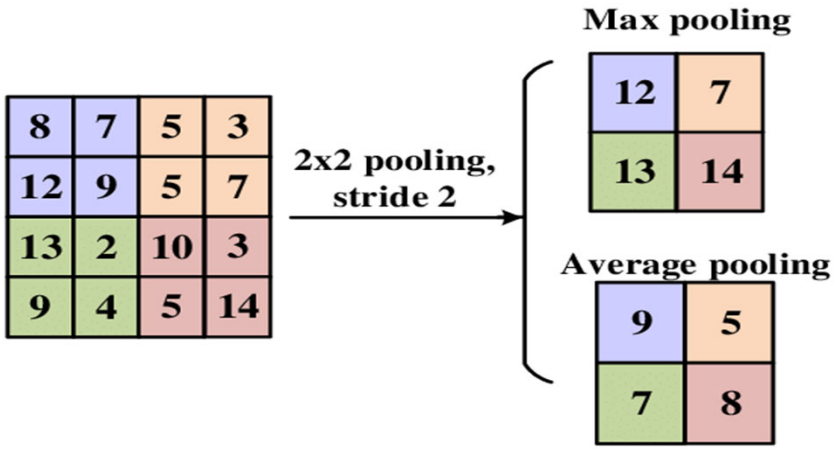
Convolution Layers

The convolution layer takes in the input data, and abstract it into a feature map. In the case of images, this converts the original image into a series of numerical values. Convolution layers can be followed by additional convolution layers, turning the model into a hierarchical model.

Breakdown of a Bicycle

Pooling Layers

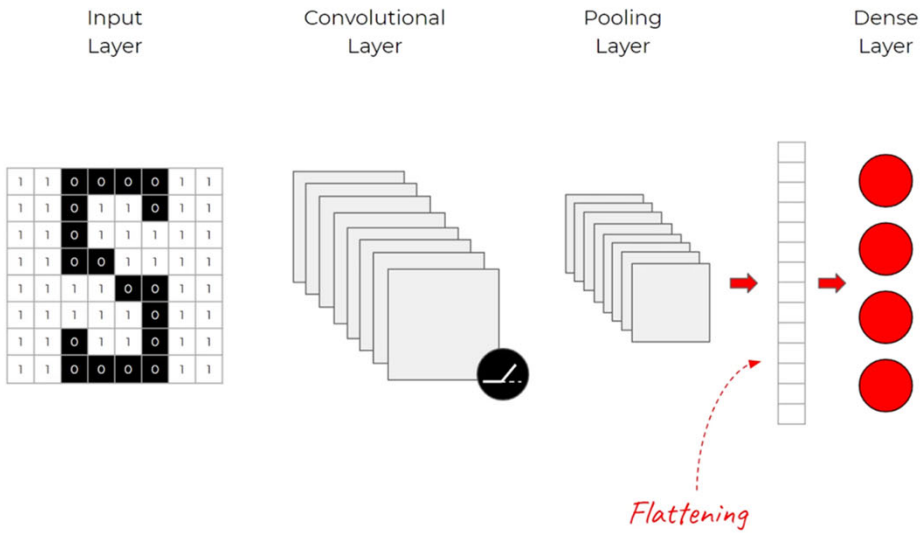
Pooling layers are also known as down sampling layers. The purpose of these layers is to reduce the dimension of the data. This is necessary to reduce the complexity of the model as well as preventing overfitting. Popular pooling methods are maximum and average.



2 Types of Pooling Methods

Flatten & Dense

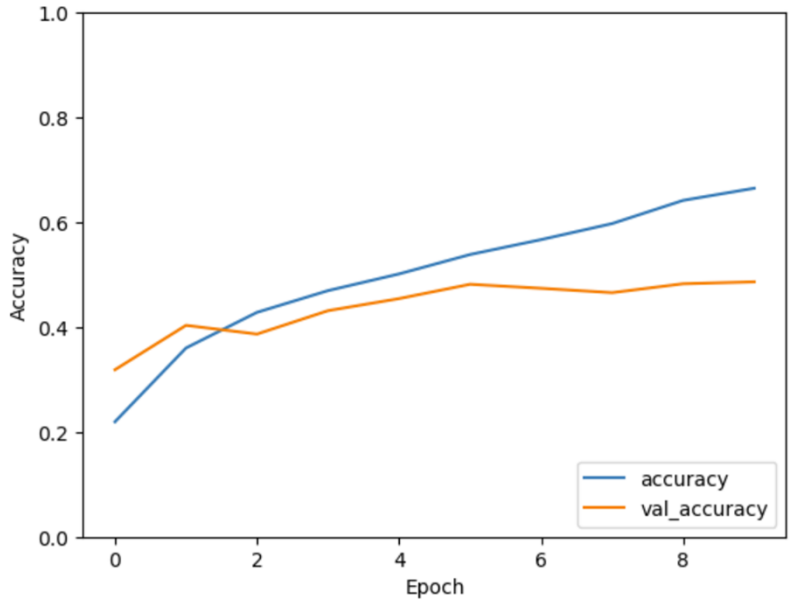
The flatten layer converts the feature map received into a format that is understood by the dense layer. A dense layer converts the result of the previous layers into the final classification that is required by the original problem.



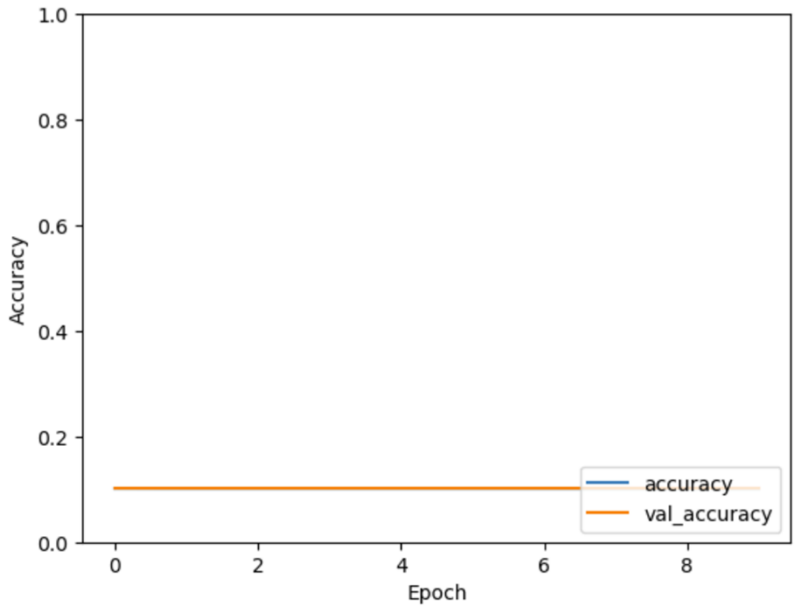
Flatten and Dense Layer

Model I On clean and noisy labels

Layer (type)	Output Shape	Param #
conv2d_3 (Conv2D)	(None, 30, 30, 32)	896
max_pooling2d_2 (MaxPooling2D)	(None, 15, 15, 32)	0
conv2d_4 (Conv2D)	(None, 13, 13, 64)	18,496
max_pooling2d_3 (MaxPooling2D)	(None, 6, 6, 64)	0
conv2d_5 (Conv2D)	(None, 4, 4, 64)	36,928
flatten_1 (Flatten)	(None, 1024)	0
dense_2 (Dense)	(None, 64)	65,600
dense_3 (Dense)	(None, 10)	650



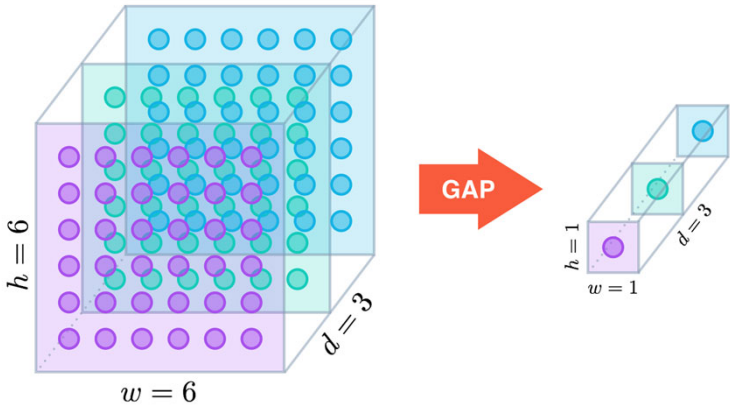
Accuracy: 0.5070000290870667
On clean labels



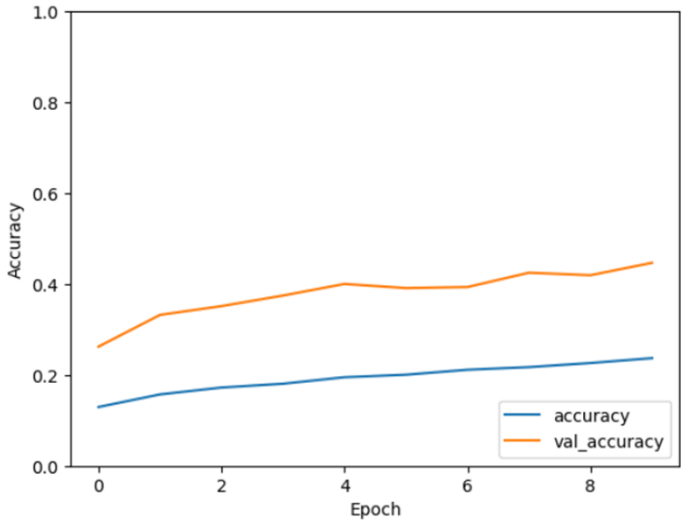
Accuracy: 0.10159999877214432
On noisy labels

Global Average Pooling

The function of GAP is to reduce the number of parameters in the model, improve the generalization ability of the model, and to a certain extent, it can replace the fully connected layer. By using GAP, the last few layers of a convolutional neural network can be replaced with a global average pooling layer and/or a 1x1 convolutional layer, simplifying the model structure and improving the performance of the model.



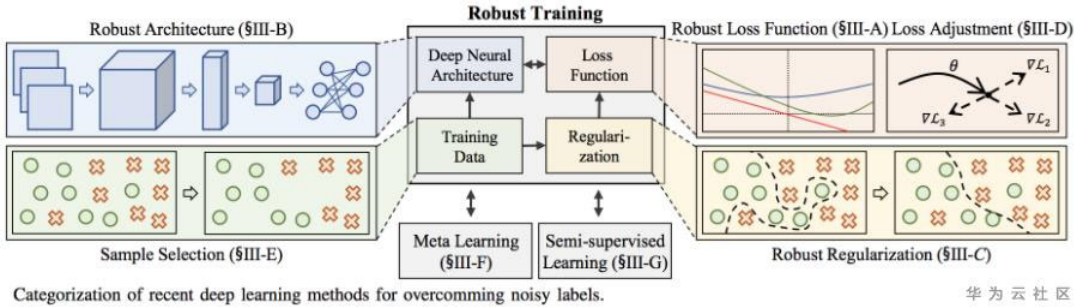
GAP diagram



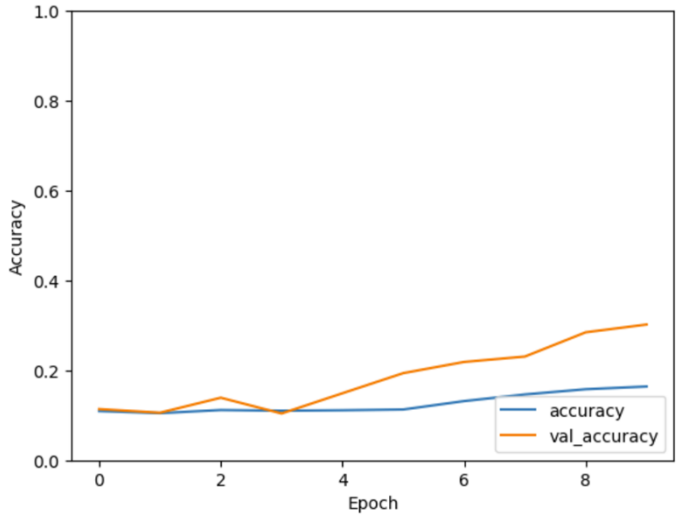
Accuracy: 0.44670000672340393

Robust Loss

The robust loss function, by introducing robustness as a continuous parameter, enables the generalization of algorithms around minimizing losses, where the robustness of losses automatically ADAPTS itself during training, thereby improving the performance of learn-based tasks.



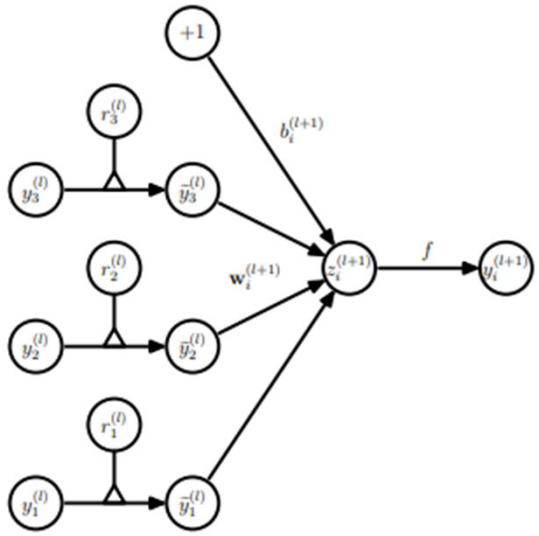
Robust Loss diagram



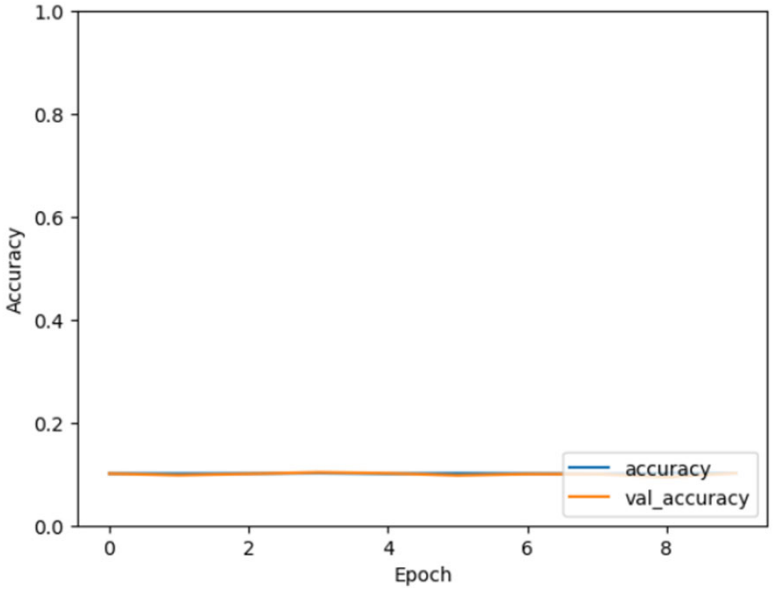
Accuracy: 0.3018999993801117

Noise Layer

In deep learning, the noise layer is not a standard component, but it can be added to the neural network to introduce additional randomness or perturbation that improves aspects of the model.



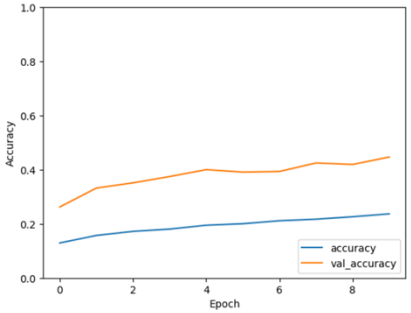
Noise Layer diagram



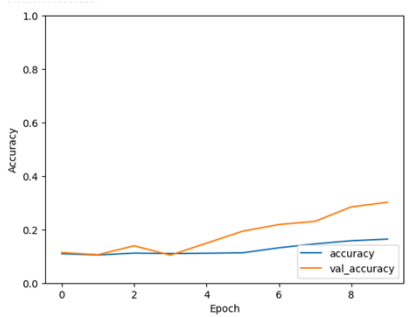
Accuracy: 0.09989999979734421

Conclusion

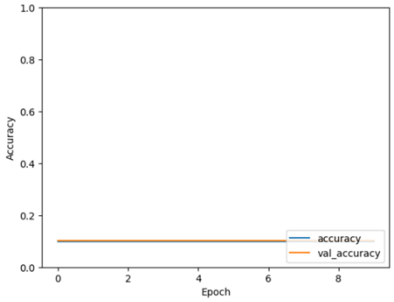
Method	Accuracy
Model I on clean labels	0.50700
Model I on noisy labels	0.10159
GlobalAveragePooling	**0.44670**
Robust Loss	0.30189
Noise Layer	0.09989



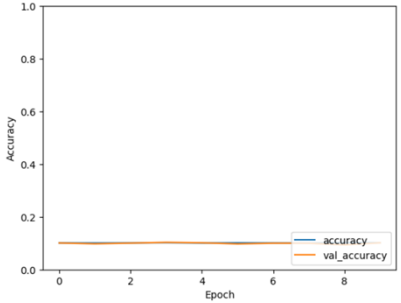
Global Average Pooling



Robust Loss



Noise Layer



Model I on noisy labels